



Monitoring CO₂ gas-phase injection in a shallow sand aquifer using cross borehole GPR

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An important issue that needs attention in designing effective storage schemes for CO₂ storage in deep geologic formations is risk assessment of potential leakage. Leaking gas may threaten surface and groundwater sources as well as vegetation. We have designed an experiment where we track the movement of an injected CO₂ gas-phase in an unconfined aquifer using cross borehole GPR. The test site is located in the south-western part of Denmark. The aquifer at the site consists of fine to coarse glacial melt water sands, which are staggered in slightly tilted layers. In all experiments gas was injected for 48 hours with flow rates between 9-16 g/min. The screen of the injection well is 10 m below ground level or 8 m below the water table. Initially an array of four GPR boreholes was installed around the injection well and subsequently two extra GPR Boreholes were installed downwards of dominating gas flow direction. GPR-data were acquired in zero offset (1D) and multiple offset (2D) configurations prior and during the injection. To support the GPR measurements 12 Decagon 5-TE soil moisture probes were installed at various depths for the last experiments. Both sets of GPR data showed that a plume developed at the depth of the injection screen and that the injected gas primarily spread towards South-East. The geology consists of slightly tilting layers, which may cause migration of the gas plume along the interface of the coarse and fine sand and out of the monitoring area. The results confirmed the notion that geological heterogeneity has a critical impact on the gas migration pattern. The gas plume migration was further analysed by the multi-phase numerical code T2VOC a part of the TOUGH family.